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Beginning to Edit Physics

Peter W. Murphy

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DISCLAIMER

BEGINNING TO EDIT PHYSICS

A physicist-turned-editor shows you the basics required for copyediting physics papers (physical quantities, symbols, units, scientific notation, the structure of mathematical expressions, the nature of graphs), and points the way to learning enough "editorial physics" to begin substantive editing.

TAKE IT STEP BY STEP

In some parts of the publishing world, one first proofreads, then copyedits, then edits lightly, and finally (if ever) edits substantively. Each step gives some preparation for the next, at least by virtue of gradual familiarization with the associated problems. For those beginning to edit physics, this paper is roughly organized along those lines: first I discuss what you need to know to copyedit physics, and then how to learn enough physics to begin editing physics substantively.

BACKGROUND FOR COPYEDITING

The *AIP Style Manual* (1) gives excellent guidance on essentially all aspects of style (and thus of copyediting) for physics journals published by the American Institute of Physics. Clements (2) gives similar guidance, with suggestions not contained in the *AIP Style Manual*. To use this guidance well, however, you must learn (if you do not already know) a number of things outside the realm of plain English. Here is a starter list of those things:

• The Greek alphabet—the names of the letters, and how to form them by hand. Any good dictionary will do. Capital letters that look like their English counterparts (Α, Β, Ε, Ζ, Η, Ι, Κ, Μ, Ν, Ο, Ρ, Τ, Χ) may be ignored. Beware: the capitol upsilon (Υ) looks like a capitol Y in some fonts, and in others it can be mistaken for a lowercase gamma!

(For credibility in speaking with your authors, learn how to speak aloud all of the names you learn, and all of the other things discussed here.)

• The names of the chemical elements and the corresponding symbols; again, any good dictionary will do.

• "Scientific notation,"(3) in which 299,800,000 becomes 2.998×10^8; also computer ("E" or "e") notation, in which 3×10^{-8} becomes 3E-08. Learn how to convert decimal quantities from one form to another.(4)

• How to figure and interpret percentages: why an increase from 5 to 50 is *not* a 1000% increase (see Appendix A).

• The significance of "significant figures": why 106 is different from 106.0.

LEARN SOME PHYSICS

You must learn some physics if you want to edit physics substantively, or even if you want to copyedit physics well. There are many excellent books from which you can learn some physics without much mathematics.(6–10)

In your reading and editing, you will encounter hundreds of terms, concepts, laws, and relations that can be regarded as part of the "technical literacy"(10) possessed by physicists and their professional audiences. Gaining some of that literacy for yourself will help you understand what you are editing, which is clearly crucial. The author has prepared a reasonable approximation of a "glossary of technical literacy"—without the definitions (see Appendix B). Look these terms up in a standard technical dictionary(11) and in your (presumably growing) library of introductory works on physics. Again, learn how to pronounce, spell, capitalize, and abbreviate them.

Technical literacy in the so-called physical quantities will repay you quickly. Learn the names and definitions of the most common physical quantities (mass, length, and time are familiar examples), the names and symbols for the units in which they are measured, and their relations to one another. Continue to learn about all the physical quantities associated with each area of physics you encounter. Such information is all to be found in a description of the International System of Units (SI).(12)

Converting physical quantities from non-SI units into SI units is generally regarded as the business of the author, but it's worth learning to do it yourself.(12)

If you're going to do some calculating, you might want a (scientific) calculator—perhaps an RPN calculator, which physicists prefer. See if you can get a software version for your computer screen, rather than an actual calculator. (A slide rule—the pocket calculator of past generations—would improve your education as well.)

LEARN SOME MATHEMATICS, TOO

Editing physics means editing mathematics. Start by learning the elements of mathematical typography.(13) To solidify your knowledge, learn to use mathematical typesetting software on a computer. Try reproducing the mathematical expressions you find in a physics text from one of the major technical publishers.

Mathematical physics depends on the use of symbols to represent physical quantities. Standard symbols are officially recognized (14); although your authors may not respect (or even know of) such standards, they may appreciate guidance. Learn to spot errors arising because of confusion of symbols by the author or a typist (e.g., α instead of $\propto$).(15)

A standard reference on copyediting mathematics will be helpful.(16) To gain sophistication, read what an eminent mathematician says to colleagues about the writing of mathematics.(17)

Eventually you must *learn* some of the mathematics used in physics. There are many friendly books to help you.(18) Start with high school mathematics, especially algebra and trigonometry; then study some calculus(19); learn something of probability and statistics, especially the statistics of observations.

Learn how to "speak" mathematics. A monograph aimed at developing this skill, for readers to blind mathematicians, is an excellent beginning point.(20)

Much of physics is represented in graphs, which you must learn to edit.(21) (Graphing software for computers may actually produce graphs more in need of editing than older techniques.(22)

READING AND WRITING PHYSICS

Read to learn more physics and to develop an ear for good physics writing. Choose publications from outside your own organization, to avoid ingrown language and ingrown publication practices. Read *New Scientist*, *Nature*, *American Scientist*, *Science*, *Scientific American*, and *[MIT] Technology Review*. Read the "Science Times" section of *The New York Times*.

Read something of what physicists are taught about writing in college,(23) and advice from a physicist on how to communicate physics ("with both the verbal and the mathematical, with emphasis on the verbal").(24) Read the complaints of a physicist about the writing of his colleagues—and the editing of editors.(25) Read some of R. P. Feynman's professional writing(26): note especially Feynman's use of language, rather than of mathematics, to make his points. Read whatever you can of *The Feynman Lectures on Physics*.(27)

COPYEDITING TIPS

Physics

• One compares the predictions of a (presumably tentative) theory with the (presumably true) corresponding observations of nature, and not the other way around.
• Speeds are higher or lower (not faster or slower); times are shorter or longer (not faster or slower); temperatures are higher or lower (not hotter or colder); magnetic fields are stronger or weaker (not larger or smaller).

SI

• The degree kelvin (°K) was replaced by the kelvin (K) in 1967; the micron (μ) became the micrometer (μm) in that year also.
• Put a space between a number and the associated unit symbol; however, leave no space between a number and the signs %, °C, °F, ° (15%; 37°C; 98.6°F; 180°).
• Be "case sensitive" when editing SI: change cap K to lowercase k for *kilo*-; change lowercase a to cap A for ampere, lowercase v to cap V for volt, etc.
• Pronounce *giga* with an initial hard *g* [the American National Standard (12) used to say "jigga," but "gigga" was uniformly used, and the standard has changed accordingly].

Mathematics

• Set subscripts and superscripts tight against their base characters, and leave no space anywhere within them.
• Except in subscripts and superscripts, leave a space on either side of the signs +, –, ×, =, <, >, etc., if they join two quantities (5×10^9).
• If the signs +, –, ×, =, <, >, etc., apply only to a single quantity that precedes or follows them, leave no space between them and the quantity ($10\times$, $<10^9$)
• Avoid script ells (ℓ): use L as the symbol for liter (SI deprecates the use of script ell for that purpose), and use italic lowercase ell (l) for algebra.
• The subscript should be a zero if it represents a standard value of a quantity; it should be an oh (o) only if it stands for a word such as "object."
• Use pairs of angular brackets, 〈 and 〉, as "fences" (representing average values, for example); use < for *less than* and > for *greater than.*
• See that physical quantities maintain their names, their symbols, and (within reason) their units throughout a paper.
• If you can, check that arguments of functions are dimensionless.
• If you can, check that the units (and vector character, if any) of all terms (things added to or subtracted from one another) in an expression are the same.

• Using two slashes in an algebraic expression or an expression of compound units (e.g., N/cm/s) renders it ambiguous; query the author and eliminate the ambiguity.
• German nouns (bremsstrahlung, hohlraum, schlieren) used in physics English are not capitalized.

English

• For light editing, start with sentence-level pruning.(28) Be sure you know what was meant before you change anything; ask if in doubt. An excellent rule of thumb is that the changes you make should produce “no surprises” at author review; work out nontrivial changes with the author before the review.

• Be careful hyphenating compound modifiers. (Hyphenate “average permeation coefficient,” “internal capsule pressure,” and “high average power laser,” for example.)

• Similarly, be careful in applying the that-vs-which distinction between restrictive and nonrestrictive clauses. (For example, consider this sentence: “This computer code differs from earlier codes in the physics which is omitted.”)

• Don’t overdo conversion from passive to active voice; it’s a thankless job. (An easy and worthwhile activation of voice is to write “Figure 1 shows …” rather than “… are shown in Fig. 1.”)

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APPENDIX A. THOUGHTS ABOUT PERCENTAGES

1. Refer Percentage Changes to the Original Value

Conventionally, a percentage change is calculated with the *initial value* in the denominator:

$$\text{Percentage change} = \frac{\text{final value} - \text{initial value}}{\text{initial value}} \times 100.$$

The change is counted as an increase if the final value is greater than the initial value, and as a decrease if it is less.

The crucial point is that the *initial value* is in the denominator. Putting the *final value* in the denominator leads to a different "percentage" value, and thus to misunderstanding on the part of a reader who assumes the conventional approach. It sometimes leads to obvious errors, as when a company is said to have suffered "100% layoffs," because (say) 400 people were laid off and 400 people were left *after* the layoff (initially there were 800 people, so that's clearly a *50% layoff*). In such extreme cases an editor can detect the error and query the author.

2. Distinguish Between Additive and Multiplicative Changes

A percentage can be associated with a given change in two ways: it can be expressed in terms of the amount of change (final value – initial value), as discussed above, or the final value can be expressed as a percentage of the initial value. So, for example, a wage reduction from $8.00 per hour to $7.20 per hour can be described as a *10% decrease:*

$$\frac{7.20 - 8.00}{8.00} \times 100 = -10\%.$$

But this reduction can also be described as a decrease *to 90% of the original wage* (not a 90% decrease!):

$$\frac{7.20}{8.00} \times 100 = 90\%.$$

Confusion arises if the words used do not reflect which approach is used. For example, it is common to hear a price increase from (say) $80 to $800 described as a 1000% increase, although the change ($800 – $80 = $720) is an increase *by 900%*. It is also correct to say that the new price is 1000% *of the old,* but the words used are crucial.

3. Use the "Factor Of" Terminology Instead of Percentages when Appropriate

Very large percentages (as in the "900% price increase" example just given in item 2) tend to overwhelm the reader; a better way to describe large increases is to take the ratio R of the final value to the initial value, and describe the change as "an increase by a factor of R." For example, a change from $80 to $800 gives a ratio of R = $800/$80 = 10, so the change is "an increase by a factor of 10."

When the change is a decrease, R is obtained by taking the ratio of the *initial value to the final value.* The change is then described as a "decrease by a factor of" that ratio. For example, a drop in price from from $800 to $80 is "a decrease by a factor of 10." In the case of simple ratios like this, the language also permits you to decribe the new price as "one-tenth" that of the old price, but this is not possible if the price has decreased by a factor of, say, 9.3. (Another, deplorable way to express this same thing is to call the new price "ten times smaller" the old price.)

4. Distinguish Percentages and "Percentage Points"

If the quantity changing is itself a percentage, the change must be carefully characterized. If unemployment in a community is 40%, for example, and that figure goes up to 48%, the percentage increase in unemployment is 20% (that is, 20% more people are unemployed than before, *if the work force has stayed the same*):

$$\frac{48 - 40}{40} \times 100 = 20\%.$$

But because unemployment is already expressed as a percentage, quoting the change as 20% can confuse the reader, who might think the unemployment rate had gone from 40% to 60%. To be unequivocal, express the change (here) from 40% to 48% as an increase "by eight *percentage points.*"

APPENDIX B. SCIENTIFIC AND TECHNICAL LITERACY FOR EDITORS

This is a compendium of terms representing the assumed common knowledge (from, say, undergraduate college courses) of physicists. These terms never need to be explained in specialist reports or in reports for general scientific audiences. Editors of physics should be familiar with their meanings.

A

A-bomb (*cf.* H-bomb)
aberration (in optical systems)
abscissa (*cf.* ordinate)
absolute (*cf.* gage) pressure
absolute temperature scale
absolute value
absolute zero
absorbed dose (radiology)
absorbed dose rate (radiology)
absorption (*cf.* adsorption)
acceleration
acceleration due to gravity (g)
accuracy (*cf.* precision)
achromatic lens
acid (*cf.* base)
action and reaction
action at a distance
activity (or a radionuclide)
adiabatic process
adsorption (*cf.* absorption)
aerosol
albedo
algorithm
alkaline earths
alloy
alpha particle, alpha decay
alternating current (AC)
AM (amplitude modulation) radio (*cf.* FM)
amino acid
ampere (unit)
Ampere's law
amplitude
analytic (*cf.* numerical) solution
angle
angle of repose
angstrom (unit)
angular acceleration
angular momentum
angular velocity
anode (*cf.* cathode)
antimatter
antinode (*cf.* node)
antiparticle
aperture (of optical system)
Archimedes' principle
area
argument (math.)
aspect ratio
astronomical unit
atmosphere (unit)
atmosphere (unit)
atom
atomic (*cf.* cgs, mks, SI) units
atomic mass unit
atomic number
atomic orbital
atomic weight
Atwood machine
audio frequency (*cf.* radio frequency)
Avogadro's law, Avogadro's number

B

Balmer series, Balmer–Rydberg formula
band (*cf.* line) spectrum
bandwidth
banking of curves
bar (unit)
barn (unit)
barometer
barrier penetration
base (*cf.* acid)
beats
becquerel (unit)
bel (*cf.* decibel) (unit)
bell curve
bending moment (torque)
Bernoulli's theorem
beta particle, beta decay
Big Bang theory
binary notation
binding energy (atomic, nuclear)
binomial theorem
blackbody, blackbody radiation
blue shift
blue sky: why?
body-centered (crystal)
Bohr hydrogen atom, Bohr radius
boiling
Boltzmann constant
Boltzmann distribution
Boolean logic
boundary conditions
Boyle's law
Bragg diffraction
branching ratio
breeder reactor
bremsstrahlung
Brewster angle
British thermal unit (Btu)
Brownian motion
bubble chamber
buffer solution
bulk modulus
buoyancy

C

"centripetal force"
calculus
calorie, kilogram calorie (units)
camera
candela (unit)
capacitance
capacitor

capillary action
capture
carbon dating
Carnot cycle, Carnot engine
Cartesian coordinates
cathode (*cf.* anode)
cathode-ray tube (CRT)
causality
Cavendish balance
cavity (*cf.* hohlraum) radiation
Celsius temperature
center of mass; center of gravity
centrifugal force
centrifuge
Cerenkov radiation
cgs (*cf.* atomic, mks, SI) units
chain reaction
charge (electric)
charge conservation
Charles and Gay-Lussac law
chart of the nuclides
chemical bond
chemical reaction
chromatic aberration
circuit
circular motion
close packing
cloud chamber
coherent radiation
complex (*cf.* imaginary, real) number
number
Compton effect
concentration (amount of substance)
condensation
conductance
conductivity
conduction (*cf.* convection)
confidence interval
conic section
conservation law
conservation of energy
conservation of momentum
conservative force
continuity equation
convection (*cf.* conduction)
coordinate system
Coriolis force
correlation
cosine law
cosmic rays
Coulomb barrier
Coulomb scattering
coulomb (unit)
Coulomb's law
covalent bond
critical angle
critical mass
critical point, temperature, pressure
Crooke's radiometer
cross (vector; *cf.* dot)) product
cross section
crystal
curie (unit)
current (electric)
current density
cyclotron
cylindrical coordinates

D

damped harmonic motion
darcy (unit)
daughter nuclide
de Broglie wavelength
Debye length
decibel (*cf.* bel) (unit)
degree of freedom
delta function
density, mass
derivative
deuterium
dew point
dewar flask
dielectric
differential
diffraction, diffraction grating
diffusion
dimensional analysis
dimensional consistency
dimensions (relation to units)
diode
dipole: magnetic, electric
Dirac delta function
direct current (DC)
direct proportion
dispersion
dissociation
dissociation energy
distribution function
doping
Doppler broadening
Doppler effect
dose equivalent (radiology)
dosimetry
dot (scalar; *cf.* cross) product
dynamics (*cf.* statics)
dyne (unit)

E

$E = h\nu$
$E = kT$
$E = mc^2$
e (base of natural logarithms)
eclipse
efficiency
eigenfunction, eigenvalue
Einstein
elastic collision
elastic limit
elasticity
electric capacitance
electric charge
electric charge density
electric conductance
electric field strength
electric flux density
electric inductance
electric potential difference
electric resistance
electrolysis
electromagnet
electromagnetic cgs units (emu)
electromagnetic field
electromagnetic induction

F

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